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United States Department of Agriculture,

DIVISION OF ENTOMOLOGY.

THE OX WARBLE.

(*Hypoderma lineata* Villers.)

GENERAL CHARACTERISTICS AND ORIGIN.

One of the worst insect enemies of cattle, especially in the great grazing regions of the West and Southwest, is the so-called ox bot, or ox warble. It bears, also, a number of other colloquial designations, such as the "ox wormal," "bot-fly," "heel fly," and is often known merely as the "grub." With reference more particularly to the injury occasioned by it, we have the terms "grubby cattle," "warbled stock," and the expressions "licked beef," or "jelly," in description of the peculiar appearance of the region infested on the beef and on the hides.

This insect (fig. 1) belongs to the family *Æstridæ*, which includes the gadflies and bot-flies, various species of which affect all of the larger herbivorous mammals, some of them living in the cavities of the body, as in the nostrils and the digestive tract, and others beneath the skin, as is the case with the species under discussion. Until comparatively recent years the general belief has been that our ox bot-fly was the common warble fly of the Old World (*Hypoderma bovis*, fig. 2), but it has been more recently shown that the only bot-fly affecting cattle so far discovered in this country

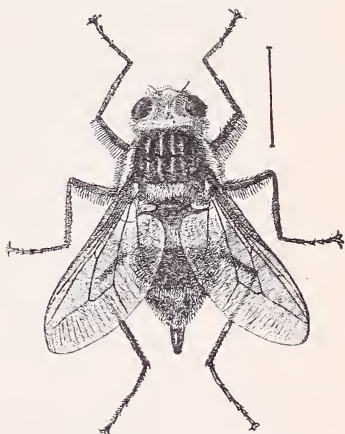


FIG. 1.—*Hypoderma lineata*—female, natural size indicated by side line (from Insect Life).

is a different species (*Hypoderma lineata*). This species is also quite abundant in Europe, where it occurs in company with the old species *H. bovis*, and often on the same animal. The *Hypoderma lineata* is a common cattle pest throughout the United States, and infests also the buffalo. In Europe it has been found from England to the regions of the Balkans and the Caucasus. Whether it is of European or American origin can not be very readily determined. It was present

in this country at a very early date, and may have been the characteristic bot-fly of our native buffalo and have been introduced into Europe from this continent. Its great abundance, however, on our domestic cattle, and its wide range in Europe, leave its origin open to doubt. It is rather remarkable, on the other hand, that the *Hypoderma bovis* has never been found in this country, occurring, as it does, rather commonly in Europe. Nevertheless, of the many hundred larvæ examined in this country by experts all of them have proved to be *lineata*, and all of the captured and reared adult insects of this nature in the various collections which have been examined prove to be of this species. At the present time, therefore, so far as known, no larvæ or adults referable to *bovis* have been collected on this side of the Atlantic.

AMOUNT AND NATURE OF DAMAGE.

Some years ago a careful investigation of the percentage of cattle infested with the ox bot in this country was made by a Western farm paper. From the averages reported from the chief cattle States of

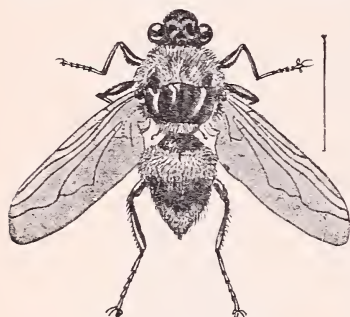


FIG. 2.—*Hypoderma bovis*—enlarged
(after Brauer).

the Mississippi Valley it was shown that 50 per cent of the cattle received in the Union stock yards at Chicago during the grubby season, which includes the months from January to June, were infested and more or less injured by the presence of the larvæ of this insect. The depreciation in the value of hides from this cause was estimated at more than a half-million dollars on the customary reduction of a dollar for a grubby hide. Adding to this the loss from the depreciated quality of the beef, together with the lessened quantity of the same from the inferior condition of affected animals, a total loss during the season in question was estimated at over three million dollars.

The appearance known as "licked beef," which results from the presence of the grub, and which may be described as a moist or running surface of a greenish-yellow color, frequently presenting a frothy or jelly-like appearance, is sufficient to condemn it for use in all first-class hotels and restaurants.

The effect upon dairy animals has been estimated by Mr. T. D. Curtis at a shrinkage of from 10 to 20 per cent of the normal yield. In England Miss Ormerod has made an estimate of the loss resulting from the presence of the larvæ of the *Hypoderma bovis*, basing her figures on reports from various practical men, showing a depreciation of from £2,000,000 to £7,000,000 sterling per annum, or as much as

£1 per head of horned cattle. This loss is shown to fall very largely on the cattle owners and also, to a less extent, on the butchers in the depreciation of the value of the carcass.

These figures seem very large and startling, but the loss is of such a nature and so widely distributed that, until comprehensive statistics like the above are collected the amount of damage annually suffered is hardly appreciated. The losses are sufficient, at any rate, to indicate that the cattle interests have few worse enemies than this bot-fly. Before entering upon the subject of remedies, the habits and life history of the insect will be briefly detailed.

LIFE HISTORY AND HABITS.

It was formerly believed that the parent bot-fly deposited its eggs on the backs of cattle, on the hair, or attached them to the skin, and

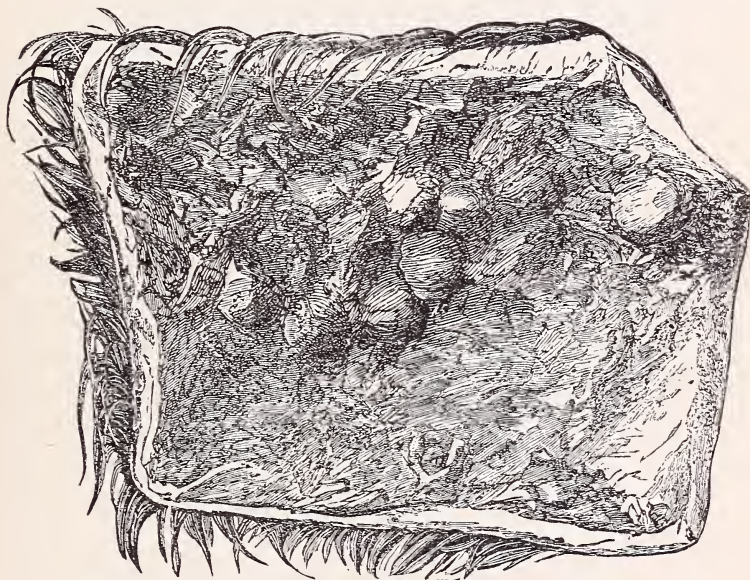


FIG. 3.—Piece of warbled hide—warbles about half size (after Ormerod).

that the young larvæ on hatching burrowed through the hide and gradually developed until they attained full growth in a cell formed by them in the connective tissue immediately beneath the skin. Dr. Cooper Curtice, who has made very careful and interesting studies of the life history of this insect, has shown that an entirely different course is followed. The facts obtained by Dr. Curtice have been supplemented by investigations, more particularly of the egg-laying habits and first stages of the larvæ, conducted through the agency of this Division. Briefly, the life habits of this insect are as follows:

Very early in the spring, as early as January or February in southwestern Texas and later northward, the flies begin to appear about

cattle and frequent their legs, and especially the region just above the hoof, for the purpose of oviposition. It is from this common habit of placing their eggs on the part of the body noted that they get the name in the South and West of "heel fly," and it may be for this reason in part that cattle almost invariably seek running water in which to stand to protect themselves from the fly. Furthermore, the fly seems not to approach the animals while standing in or over water, even if the parts where the eggs are likely to be placed are above water, as with animals standing on exposed rocks in streams.

The eggs are also placed occasionally, if not frequently, on other parts of the body, as the flanks and lower portions generally. In one instance a correspondent observed an old and feeble animal, which had lain down and could not get up to escape, attacked by some

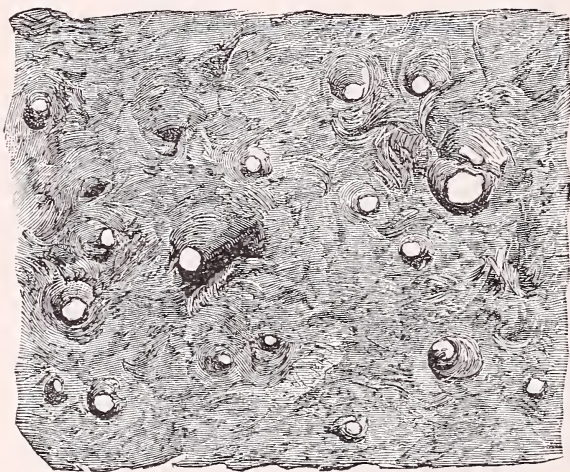


FIG. 4.—Portion of inside of tanned warbled hide (after Ormerod).

fifty flies, which were observed about her at one time. A dozen or more of these flies were afterward captured and submitted to us for identification, together with a large number of eggs, from which our illustrations were made.

Along the Pedernales River cattle would come to the water to escape the flies as early as 9 o'clock in the morning and remain there, for the most part standing on exposed rocks in the stream, until 5 o'clock in the evening. In the meantime the flies were observed along the banks of the stream in extraordinary numbers, but none of them seemed to care to approach the cattle.

One of the most noticeable features connected with the presence of this fly among cattle is the intense excitement which it causes, often amounting to frenzy, stampeding the stock and causing them to run violently through shrubbery or to water where the fly will not follow

them. This can not come from any pain caused by the placing of the eggs on the animals, but must be from an instinctive dread of the insect, and is analogous to the similar frantic actions of the horse when approached by the throat bot.

The injury to fattening range cattle in the spring is due very largely to the annoyance occasioned by the presence of the fly. A Texas correspondent, Mr. George W. Holstein, calls attention to this fact as follows: "A cow quietly grazing will suddenly spring forward, throw up her tail, and make for the nearest water at a headlong gait. Seemingly deprived at the moment of every instinct except the desire to escape, she will rush over a high bluff if in the way, often being

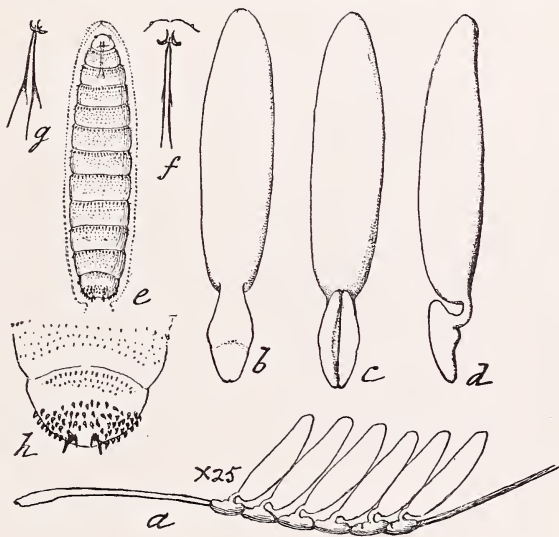


FIG. 5.—*Hypoderma lineata*: a, eggs attached to hair; b, c, d, dorsal, ventral, and lateral view of egg; e, embryonic or first larva, as seen in egg; f, g, mouth parts of same enlarged; h, anal segments of same still more enlarged (from Insect Life).

killed by the fall. This, with miring in water holes and the fact that cattle are prevented from feeding, causes the loss."

As observed, in the act of egg-laying the flies approach the cattle very swiftly, being almost too quick in flight to be observed except at the very moment of placing the eggs. The eggs are fastened to the hairs, in the examples received here usually four to six together. The structure of the lower portion of the egg is of such a nature that it clasps the hair almost entirely and forms a very firm and strong attachment. The peculiar shape of the egg is shown in the illustration (fig. 5). In length it measures about two millimeters, and is of a dull yellowish-white color. The ovipositor, extended as in the act of placing the egg, is represented in fig. 6.

The eggs once in position, the larvæ probably rather than the eggs, are carried into the mouth by means of the licking of the leg and the

region about the hoof and flanks of the animal. As seen from the examination of our material, the egg, as soon as deposited, has the larva already formed in it, and it is probable that the young larva escapes from the egg at the moment it is conveyed to the mouth, the pressure and moisture of the tongue facilitating its escape. The egg, at any rate, splits readily at the anterior end, and the young larva being conveyed into the mouth soon penetrates the esophagus by means of its strong spines, which are represented in the illustration (fig. 5, *e*, *h*). These young larvæ have been found in the walls of the esophagus, and it is not until about the end of December that they appear in any numbers in the back.



FIG. 6.—*Hypoderma lineata*—ovipositor of female: *a*, from side; *b*, tip, from below—enlarged (from Insect Life).

After penetrating the esophagus, the larva soon moults and assumes a nearly smooth surface (fig. 7), and for several months wanders through the connective tissue of its host between the skin and the flesh, penetrating gradually along the neck and ultimately reaching a point beneath the skin in the region of the back. In the meantime all traces of the larvæ or attending inflammation disappear from the region of the esophagus. The “lick,” according to Dr. Curtice, is nothing more than an effusion of serum in the connective tissue caused by the inflammation induced by the wanderings of the young grubs.

When the final position in the back is reached the larva moults again, becomes more spiny, and penetrates or bores a hole through the skin, caudal end first, through which it gets air for respiration at this stage. At this time the anal spiracles, or breathing pores (fig. 8, *d*, *f*), are much more prominent than they were during the long period of the wandering life of the larva, when respiration must necessarily be very limited. The larva now develops much more rapidly, subsisting on the pus and bloody serum which its presence beneath the skin induces. The final moult soon follows, which brings it to the form that is commonly seen by stockmen (fig. 8, *g*, *i*).

When full grown the larva has a length of more than an inch and is rather robust and of a yellowish-white color. It works its way out by means of its strong spiny covering through the hole which it has previously used as a source of air, drops to the ground, which it may or may not enter, but, at any rate, contracts and hardens,

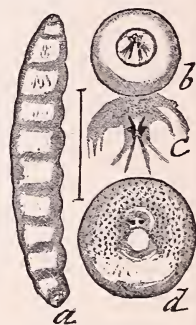


FIG. 7.—*Hypoderma lineata*—second stage of larva from esophagus: *a*, larva; *b*, enlargement of cephalic segments, end view; *c*, mouth parts; *d*, enlarged end view of anal segment, showing spiracles and spines (from Insect Life).

and gradually darkens, ultimately becoming almost black in color. This contracted and hardened larva is what is known as the puparium, which, except for its changed color, texture, and shape, preserves all of the characteristics of the larva. From three to six weeks later the perfect fly escapes by pushing off a sort of circular piece or cap at one end of the puparium. The illustration (fig. 9) represents this stage in the allied species, *bovis*.

The establishment of the wandering habits of the larva in its early stages and the fact of its entrance into the animal through the mouth and esophagus, instead of the skin of the back, is based on careful experiments and examinations conducted by Dr. Curtice, and is apparently now well established, though differing so radically from the

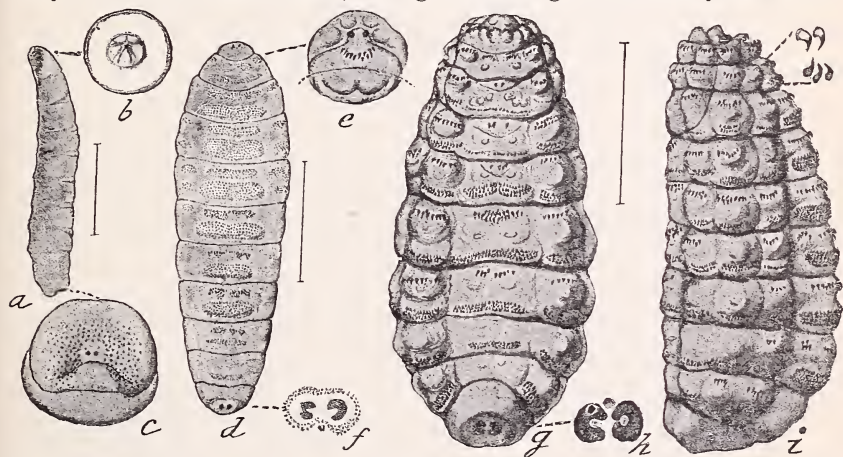


FIG. 8.—*Hypoderma lineata*: a, second stage of larva from back; b and c, enlargement of extremities; d, ventral view of third stage with details of extremities at e and f; g, dorsal view of mature larva with enlargement of anal spiracles at h; i, the same, lateral view—natural size indicated by side lines (from Insect Life).

views formerly held. The wandering habits of this larva are further indicated by a number of well-authenticated cases of its occurrence beneath the skin of the human subject. There it has usually exhibited a similar wandering tendency, in one instance having covered a distance of several yards before being removed. This particular larva is represented in the accompanying illustration (fig. 10). Its entrance into the human subject can be easily accounted for by supposing it to be taken with milk.

In general appearance and size, the adult insect, roughly speaking, is not unlike the common honeybee. It is about one-half an inch long, the general color black, and is clothed with yellowish-white and reddish-brown and black hairs. The margin of the head and thorax and a band on the base of the abdomen are covered with long whitish hairs. The upper surface of the head and thorax, and the middle segments of the abdomen, together with the legs, are covered

with brownish-black hairs. There are four raised lines on the thorax, which are polished and shining, as shown in the illustration (fig. 1). The hairs on the tip of the body are reddish-brown.

The European bot-fly (*Hypoderma bovis*) is a much larger insect, and is strongly banded with yellow and black, as indicated in fig. 2, the light areas representing the yellow color.

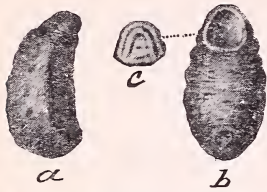


FIG. 9.—*Hypoderma bovis*: a, puparium, from side; b, same, from above, showing exit hole of adult; c, cap which splits off to allow the adult to issue—natural size (after Clark).

PREVENTIVES AND REMEDIES.

It is possible to greatly diminish the loss occasioned by the ox bot, and this is notably true of the smaller herds belonging to the general farmer, dairyman, and to the raiser of improved breeds, which are better cared for and more easily handled. For the great herds of half-wild cattle covering the extensive grazing districts of the West and Southwest, any treatment becomes a matter of extreme difficulty and will often be impracticable. Even in such cases, however, it may be possible to prevent excessive loss, as will be indicated below.

The common means of preventing the attacks of this fly and of killing the larvæ after they have reached their final location in the back are of very ancient origin, having been referred to, in fact, by Pliny, writing in the first century of our era, and were probably known much earlier. Nothing better has been found for the purpose in modern times, although the methods are perhaps more effective now on account of the better knowledge of the habits of the insect.

The substances used are any strong smelling oils and fats, by means of which it is possible to prevent the fly from depositing its eggs on the animal and also to kill the larvæ in their final stages in the back. The larvæ, during their early and wandering stages, are out of reach, and it is impossible to kill them.

The oils commonly used for the purposes mentioned are the train oils or fish oils, either alone or with sulphur or carbolic acid mixed. The addition of the latter is especially favorable to the healing of sores and diseased places left by the grubs. Common axle grease may be used for the same pur-

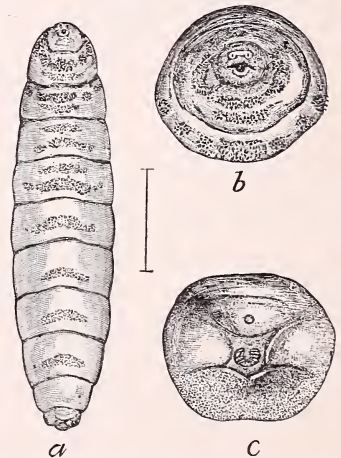


FIG. 10.—Larva, probably of *Hypoderma lineata*, taken from boy: a, ventral surface; b, anterior end; c, anal end—all enlarged (from Insect Life).

pose; also any other strong smelling grease or oil, with or without the additions mentioned.

To protect the animals from the attacks of the fly, or in other words to deter the fly from placing its eggs on them, it is necessary to smear or spray the oil or grease on the legs, flanks, or other parts of the animal most likely to be approached. The more pungent the substance used the better for the purpose. The applications will have to be kept up during spring and early summer, and hence are very difficult and expensive, and perhaps impracticable except in the case of small herds of valuable cattle, dairy animals, and work cattle or oxen. A correspondent writes that he has protected his work oxen from the annoyance of this fly by keeping their heels smeared with kerosene, applied by means of a rag tied to a long stick. He says: "The steers soon learned the benefit and would allow me to apply the oil without kicking." In general, this treatment is probably out of the question for range stock.

The application of oils is often recommended to kill the grubs in the backs of animals, either smearing the substance liberally over the infested region, or preferably applying it at the mouth of the breathing hole of the grub, the location of which is indicated by a hard swelling and a slight exudation of pus. The grubs are killed by the closing with the oil of the pores through which they breathe and which penetrate nearly to the end of the hole in the skin. One or two applications during the winter are said to be sufficient. The grubs may be killed also by placing a small quantity of mercurial ointment in the hole, or a few drops of spirits of turpentine, carbolic acid, or kerosene, and further by piercing them with some sharp instrument.

There is one objection to this method of killing the grubs, viz, that the dead grub remains beneath the skin of the animal and may cause an abscess or suppuration by its subsequent decay. These methods of treatment, however, have been long recommended both in this country and Europe and no bad results have been reported.

Wherever it is practicable, however, the grub should be entirely removed, and this may be effected by applying pressure on either side of the swelling indicating the presence of the grub, forcing the latter out. Dr. D. E. Salmon reports that the grubs may be very successfully removed by means of small tweezers, applying a slight pressure with the fingers to cause the grub to slightly protrude, then drawing it fully out with the tweezers.

The benefit following the removal of the grubs is immediate, and will repay considerable trouble in its accomplishment.

If by such winter treatment the majority of the larvæ can be killed or removed from the backs of the cattle, this in itself will furnish considerable protection for range cattle if it be generally adopted. This

is, at least, about the only step which presents any practical possibilities for the great grazing districts of the West and Southwest.

As a rule, the application of these remedies will necessitate means of bringing the animals into close quarters in small pens, and is necessarily attended with some expense and considerable labor.

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Approved:

JAMES WILSON,

Secretary.

WASHINGTON, D. C., *July 19, 1897.*



